Amended Claims – With Markings To Show Changes Made

CLAIMS

What is claimed is:

1. An amorphous metal stator for a radial flux motor having a rotor, said stator comprising a plurality of segments, each segment comprising a plurality of layers of amorphous metal strips, each of has a top and a bottom surface and is oriented such that (i) a line normal to either of said surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of said rotor, and (ii) when traversing said segment, said flux crosses one air gap.

2. An amorphous metal stator as recited by claim 1, each of said segments further comprising:
   a). a back-iron section having a first free end and comprising a plurality of contactingly stacked layers of amorphous metal strips; and
   b) a tooth section having a first free end and comprising a plurality of contactingly stacked layers of amorphous metal strips;

   said back-iron section and said tooth section being arranged such that said first free end of said back-iron section contactingly engages said first free end of said tooth section and wherein an air gap is defined between said respective first free ends.

3. An amorphous metal stator as recited by claim 2, further comprising:
   c) an inner restraining means for securing said tooth section against being drawn out of engagement with said back-iron section; and
   d). an outer restraining means for securing said plurality of segments in generally circular abutting relation to each other.

4. An amorphous metal stator as recited by claim 3, wherein said inner restraining means comprises a bonding material that is applied to a substantial portion of said stator to provide each of said segments with increased mechanical strength, and said outer restraining means comprises a steel band provided peripherally about said stator.

5. An amorphous metal stator as recited by claim 3, wherein said inner restraining means comprises a bonding material that is applied to a substantial portion of said stator, excluding said respective first free ends of said back-iron and tooth sections.

6. An amorphous metal stator as recited by claim 4, wherein said bonding material is an epoxy resin.

7. An amorphous metal stator as recited by claim 3, wherein said inner restraining means partly comprises a bonding material and partly comprises a metal band.

8. An amorphous metal stator as recited by claim 2, said back-iron section being generally arcuate and said tooth section being generally straight.

9. An amorphous metal stator as recited by claim 1, each of said amorphous metal strips having a composition defined essentially by the formula: $M_{70-85}\ Y_{5-20}\ Z_{0-20}$, subscripts in atom percent, where "M" is at least one of Fe, Ni and Co, "Y" is at least one of B, C and P, and "Z" is at least one of Si, Al and Ge; with the provisos that (i) up to 10 atom percent of component "M" can be replaced with at least one of the metallic species Ti, V, Cr, Mn, Cu, Zr, Nb, Mo, Ta, Hf, Ag, Au, Pd, Pt, and W; (ii) up to 10 atom percent of components (Y + Z) can be replaced by at least one of the non-metallic species In, Sn, Sb and Pb; and (iii) up to about one (1) atom percent of the components (M + Y + Z) can be incidental impurities.

10. An amorphous metal stator as recited by claim 9, wherein each of said amorphous metal strips has a composition containing at least 70 atom percent Fe, at least 5 atom percent B, and at least 5 atom percent Si, with the proviso that the total content of B and Si is at least 15 atom percent.

11. An amorphous metal stator as recited by claim 10 wherein each of said amorphous metal strips has a composition defined essentially by the formula $Fe_{80}B_{11}Si_9$.

12. An amorphous metal stator as recited by claim 9, said amorphous metal strips having been heat treated to form a nanocrystalline microstructure therein.

13. An amorphous metal stator as recited by claim 12, wherein each of said amorphous metal strips has a composition defined essentially by the formula $Fe_{100-u-x-y-z-w}R_uT_xQ_yB_zSi_w$, wherein R is at least one of Ni and Co, T is at least one of Ti, Zr, Hf, V, Nb, Ta, Mo, and W, Q is at least one of Cu, Ag, Au, Pd, and Pt, u ranges from 0 to about 10, x ranges from about 3 to 12, y ranges from 0 to about 4, z ranges from about 5 to 12, and w ranges from 0 to less than about 8.

14. An amorphous metal stator as recited by claim 12, wherein each of said amorphous metal strips has a composition defined essentially by the formula $Fe_{100-u-x-y-z-w}R_uT_xQ_yB_zSi_w$, wherein R is at least one of Ni and Co, T is at least one of Ti, Zr, Hf, V, Nb, Ta, Mo, and W, Q is at least one of Cu, Ag, Au, Pd, and Pt, u ranges from 0 to about 10, x ranges from about 1 to 5, y ranges from 0 to about 3, z ranges from about 5 to 12, and w ranges from about 8 to 18.

15. An amorphous metal stator as recited by claim 1, said stator having a core loss less than "L" when operated at an excitation frequency "f" to a peak induction level B_{max} wherein L is given by the formula $L = 0.0074 f (B_{max})^{1.3} + 0.000282 f^{1.5} (B_{max})^{2.4}$, said core loss, said excitation frequency and said peak induction

level being measured in watts per kilogram, hertz, and teslas, respectively.

16. An amorphous metal stator as recited by claim 15, said stator having a core-loss less than or approximately equal to 1 watt-per-kilogram of amorphous metal material when operated at a frequency of approximately 60 Hz and a flux density of approximately 1.4T.

17. An amorphous metal stator as recited in claim 15, said stator having a core-loss of less than or approximately equal to 12 watts-per-kilogram of amorphous metal material when operated at a frequency of approximately 1000 Hz and a flux density of approximately 1.0T.

18. An amorphous metal stator as recited in claim 15, said stator having a core-loss of less than or approximately equal to 70 watts-per-kilogram of amorphous metal material when operated at a frequency of approximately 20,000 Hz and a flux density of approximately 0.30T.

19. An amorphous metal stator as recited in claim 1, each of said segments having been subjected to a heat treatment comprising a heating and a cooling portion.

20. An amorphous metal stator as recited in claim 19, a magnetic field having been applied to each of said segments during at least the cooling portion of the heat treatment thereof.

21. An amorphous metal stator as recited in claim 19, said heat treatment having been carried out in a batch or continuous annealing oven

22. An amorphous metal stator for a radial flux motor having a rotor, said stator comprising a plurality of segments, each segment having a plurality of layers of amorphous metal strips, each of has a top and a bottom surface and is oriented such that (i) a line normal to either of

said surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of said rotor, and (ii) said flux traverses said segment without crossing an air gap, said stator further comprising:

a) an inner restraining means for protecting and strengthening at least said tooth section; and

b) an outer restraining means for securing said plurality of segments in generally circular abutting relation to each other.

23. An amorphous metal stator as recited by claim 22, wherein said inner restraining means comprises a bonding material that is applied to a substantial portion of said stator and that provides each of said segments with increased mechanical strength and wherein said outer restraining means comprises a steel band provided peripherally about said stator.

24. An amorphous metal stator as recited by claim 23, wherein said bonding material is an epoxy resin.

25. An amorphous metal stator as recited by claim 22, wherein said inner restraining means partly comprises a bonding material and partly comprises a metal band.

26. An amorphous metal stator for a radial flux motor having a rotor, said stator comprising a plurality of segments, each segment having a plurality of layers of amorphous metal strips, each of has a top and a bottom surface and is oriented such that (i) a line normal to either of said surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of said rotor, and (ii) said flux traverses said segment without crossing an air gap, said stator having a core loss less than "L" when operated at an excitation frequency "f" to a peak induction level B_{max} wherein L is given by the formula $L = 0.0074 f (B_{max})^{1.3} + 0.000282 f^{1.5} (B_{max})^{2.4}$, said core loss, said excitation frequency and said peak induction level being

measured in watts per kilogram, hertz, and teslas, respectively.

27. An amorphous metal stator as recited in claim 26, said stator further comprising:

a) an inner restraining means for protecting and strengthening at least said tooth section; and

b) an outer restraining means for securing said plurality of segments in generally circular abutting relation to each other.

28. An amorphous metal stator as recited in claim 26, each of said segments having been subjected to a heat treatment comprising a heating and a cooling portion.

29. An amorphous metal stator as recited in claim 28, a magnetic field being applied to each of said segments during at least the cooling portion of the heat treatment thereof.

30. An amorphous metal stator as recited in claim 28, said heat treatment being carried out in a batch or continuous annealing oven.

31. An amorphous metal stator as recited by claim 26, said stator having a core-loss less than or approximately equal to 1 watt-per-kilogram of amorphous metal material when operated at a frequency of approximately 60 Hz and a flux density of approximately 1.4T.

32. An amorphous metal stator as recited in claim 26, said stator having a core-loss of less than or approximately equal to 12 watts-per-kilogram of amorphous metal material when operated at a frequency of approximately 1000 Hz and a flux density of approximately 1.0T.

33. An amorphous metal stator as recited in claim 26, said stator having a core-loss of less than or approximately equal to 70 watts-per-kilogram of amorphous metal material when operated at a frequency of approximately 20,000 Hz and a flux density of approximately 0.30T.

34. An amorphous metal stator as recited in claim 26, wherein each of said strips has a composition defined essentially by the formula: $M_{70-85}\ Y_{5-20}\ Z_{0-20}$, subscripts in atom percent, where "M" is at least one of Fe, Ni and Co, "Y" is at least one of B, C and P, and "Z" is at least one of Si, Al and Ge; with the provisos that (i) up to 10 atom percent of component "M" can be replaced with at least one of the metallic species Ti, V, Cr, Mn, Cu, Zr, Nb, Mo, Ta, Hf, Ag, Au, Pd, Pt, and W; (ii) up to 10 atom percent of components (Y + Z) can be replaced by at least one of the non-metallic species In, Sn, Sb and Pb; and (iii) up to about one (1) atom percent of the components (M + Y + Z) can be incidental impurities.

35. A brushless radial flux DC motor comprising:

a) an amorphous metal stator and a rotor disposed for rotation therewithin, said stator comprising a plurality of segments, each segment comprising a plurality of layers of amorphous metal strips, each of has a top and a bottom surface and is oriented such that (i) a line normal to either of said surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of said rotor, and (ii) when traversing said segment, said flux crosses one air gap; and

b) means for supporting said stator and said rotor in predetermined positions relative to each other.

36. A brushless radial flux DC motor comprising:

a) an amorphous metal stator and a rotor disposed for rotation therewithin, said stator comprising a plurality of heat-treated segments, each segment comprising a plurality of layers of amorphous metal strips,

each of has a top and a bottom surface and is oriented such that (i) a line normal to either of said surfaces at substantially any point thereon is substantially perpendicular to the axis of rotation of said rotor, and (ii) said flux traverses said segment without crossing an air gap, and said stator having a core loss less than "L" when operated at an excitation frequency "f" to a peak induction level B_{max} wherein L is given by the formula $L = 0.0074\, f\, (B_{max})^{1.3} + 0.000282\, f^{1.5}\, (B_{max})^{2.4}$, said core loss, said excitation frequency and said peak induction level being measured in watts per kilogram, hertz, and teslas, respectively; and

b) means for supporting said stator and said rotor in predetermined positions relative to each other.